

[54] **MULTIPLE POINT ALARM SYSTEM
WITH TWO STATE ALARM SWITCHES**

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[58] Field of Search.....**340/412**

[56] **References Cited**

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[57] **ABSTRACT**

An alarm system for monitoring a number of alarm points arranged in groups or zones at areas remote from a central station which permits identification of more than one alarm point in a group that may present an alarm condition without first requiring correction of the condition giving rise to a prior occurring alarm condition within the group. The system includes a plurality of zone encoders connected to the alarm switches and responsive to operation thereof to an alarm position for providing a pulse output to a zone identification circuit, followed by a constant d.c. output which remains as long as the alarm switch is in the alarm position. The system will identify the group or zone which presents even a momentary alarm condition and should it be a repetitive momentary alarm condition, the specific alarm point in the zone or group can be identified.

8 Claims, 2 Drawing Figures

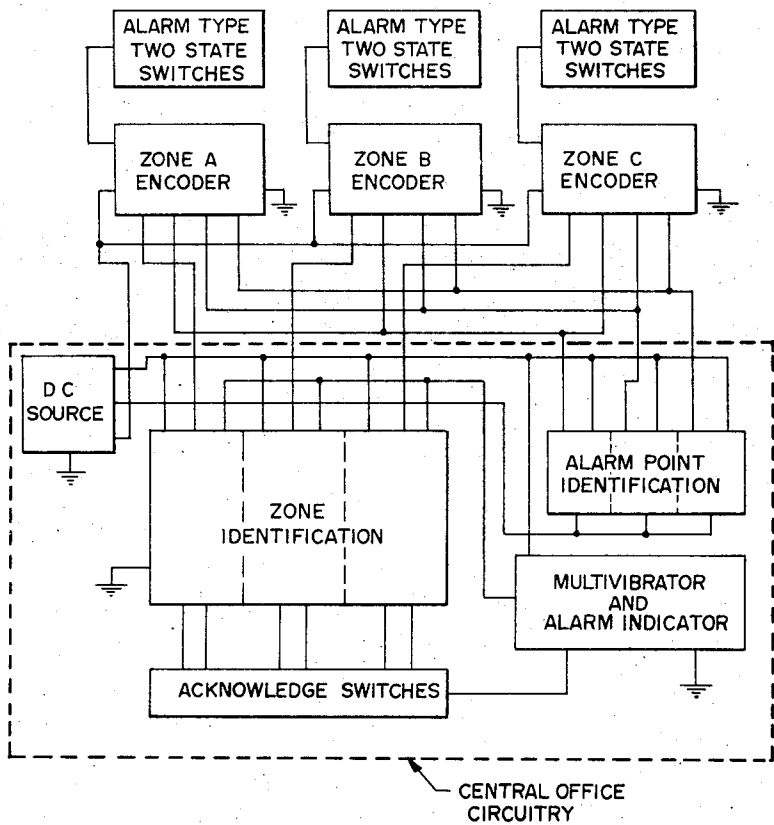
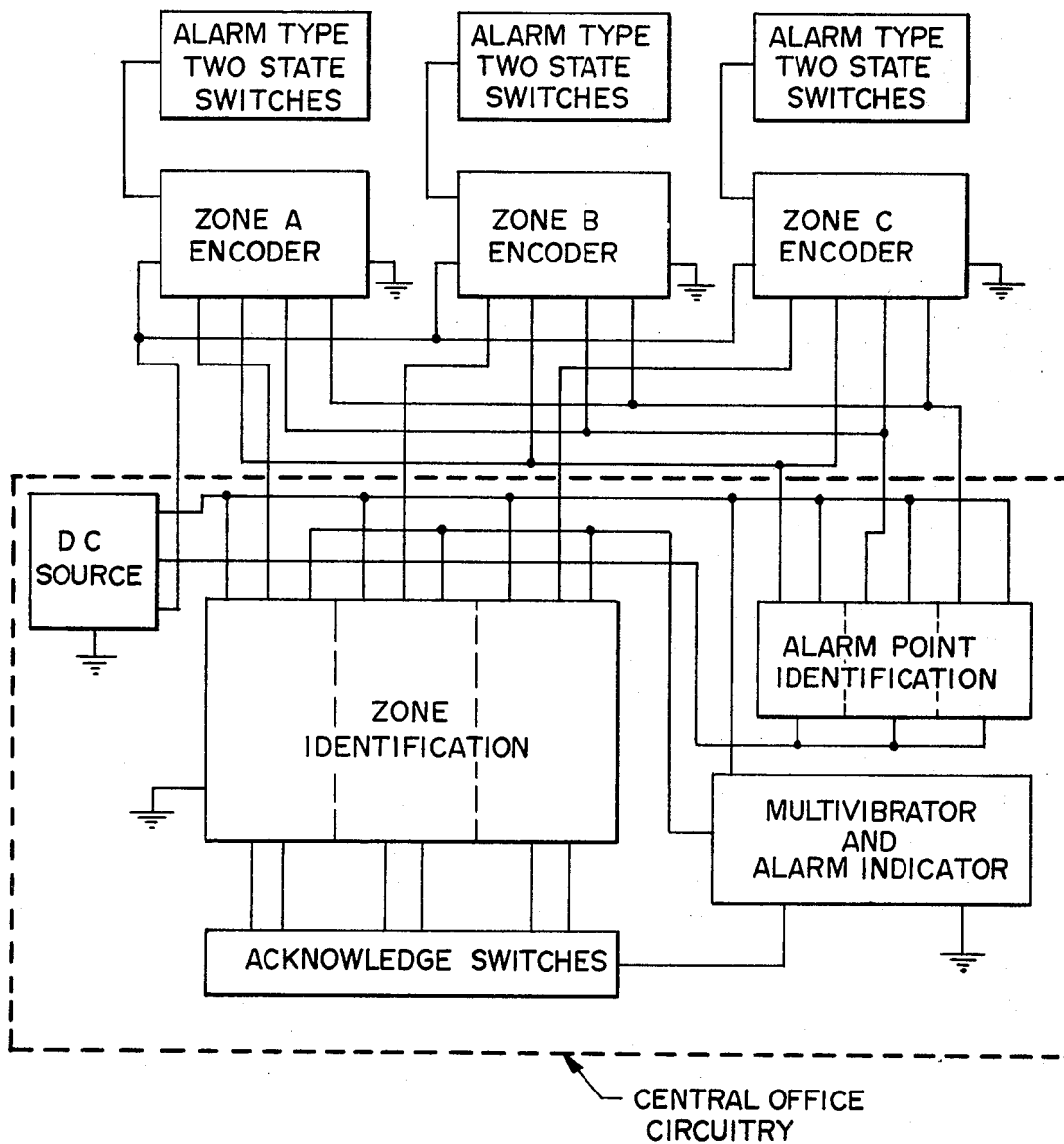


FIG. 1



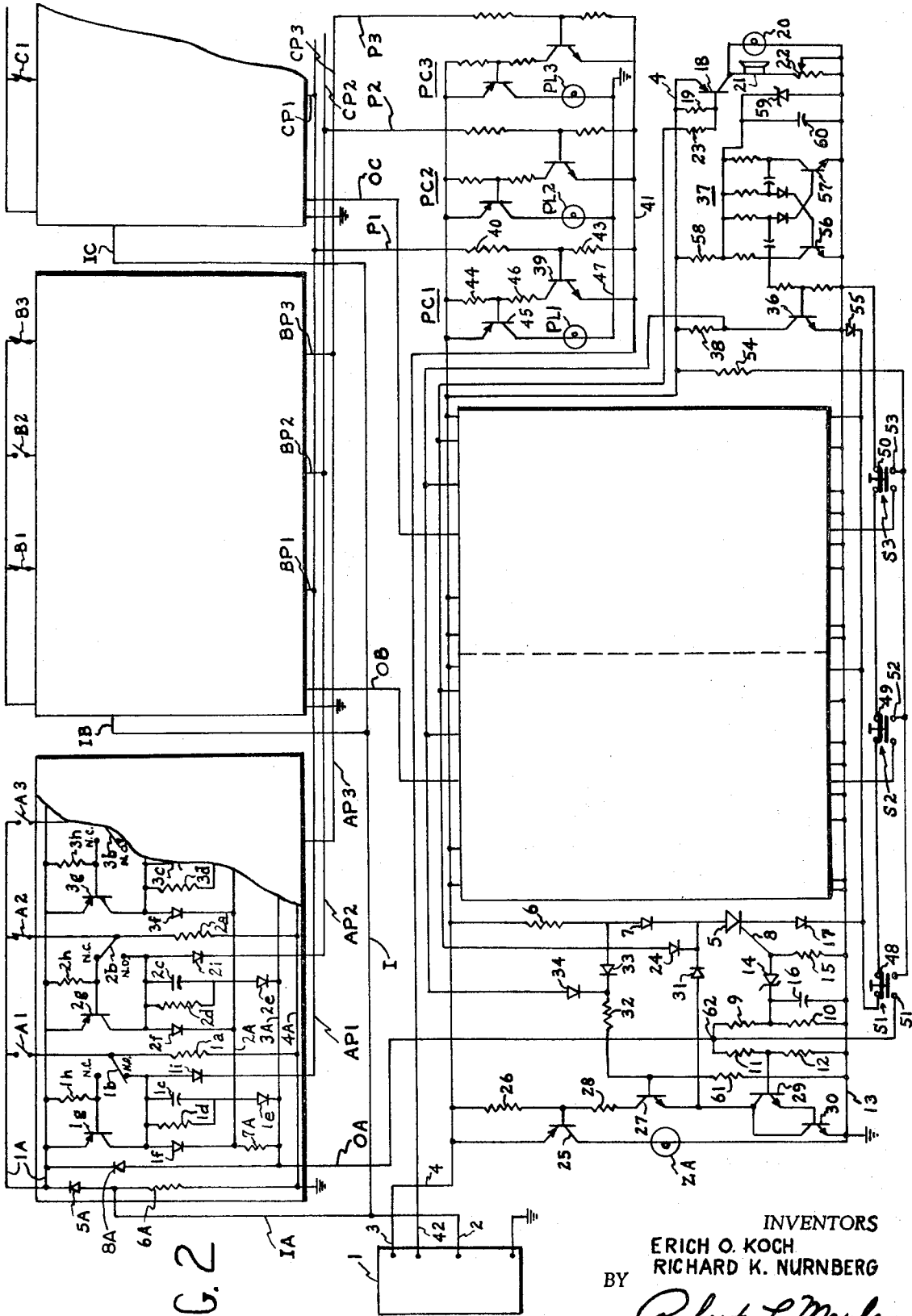


FIG. 2

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MULTIPLE POINT ALARM SYSTEM WITH TWO STATE ALARM SWITCHES

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to alarm or annunciator systems for monitoring at a central location the operation of equipment located at remote points. Such systems provide an audible and/or visual indication at a central console when an alarm point detects a malfunction. More particularly, this invention is directed to such systems with provision made to detect and identify more than one alarm condition in a group of alarm points without having to first correct the initial alarm condition detected.

2. Description of the Prior Art

The prior art, as exemplified by U. S. Pat. No. 3,447,145; No. 3,451,058 and No. 3,518,653 discloses alarm or annunciator systems for monitoring the operation of equipment and sensing conditions at various points remote from a central office. The use of multiplexing techniques to reduce the number of wires needed to receive a signal from a point when it is in the alarm condition and to identify the point in alarm is shown in the prior art. A number of separate surveillance zones are established with each zone having circuitry for connection to the alarm points for the zone. An alarm condition is sensed by the opening or closing of a set of contacts. Whether normally closed or normally open contacts are used is dictated by the condition or operation being sensed.

Movement to the alarm position of a set of alarm contacts in a surveillance zone circuitry causes a signal to be sent to the central office circuitry where it is effective to initiate an audible and/or visual alarm and cause a light to be illuminated to identify the surveillance zone that is presenting an alarm condition. Alarm acknowledging circuitry is provided, which when initiated following the receipt of an alarm signal, serves to silence the audible alarm while leaving the zone identifying light energized. The control circuitry is at the same time conditioned to respond to an alarm condition that may occur at another surveillance zone.

With the zone identified it is necessary to establish the alarm point that is in alarm so corrective action can be taken. Alarm point identifying circuitry is provided at the central office. The point identification circuitry is energized via selective operation of a switch to apply a voltage from the central office via a single wire to the zone circuitry presenting an alarm condition, thence via the circuitry associated with the point that is in alarm to point identification circuitry at the central office via a wire associated with the alarm point. The alarm point identification circuitry associated with the alarm point in alarm condition is thus energized to provide a visual indication of the point that is in alarm.

These general functions are provided by the prior art as exemplified by the patents and patent application mentioned heretofore.

While the prior art systems will detect an initial alarm condition that may occur at an alarm point for a given surveillance zone circuitry, such systems will not detect a second alarm condition for such zone that may occur subsequent to the initial alarm condition and prior to correction of the initial alarm condition. Thus, the prior art systems will only allow an operator to

identify the first point that may be in alarm in a given zone. One or more points in the zone may subsequently move to an alarm position, but will not be detected until the prior alarm condition has been corrected. The disadvantages of such a system are obvious making it desirable to have an alarm system which can detect and identify more than one alarm condition for a given zone without first correcting the first alarm condition that occurs. It is obvious that this can be done by using a separate wire to connect each alarm point with the central office circuitry, but this would mean giving up the savings provided by multiplexing techniques used in the prior art systems. It is desirable therefore that the new feature mentioned be obtained while still retaining the multiplex type connections for connecting the various alarm points and zone circuitry with the central office.

SUMMARY OF THE INVENTION

An object of the present invention is to provide an alarm or surveillance system of the general type described above capable of detecting more than one alarm condition in a given zone without first correcting a prior occurring alarm producing condition.

Another object of the present invention is to provide an alarm or surveillance system of the general type mentioned in the description of the prior art capable of identifying the zone in which a momentary alarm condition may occur and to also identify the alarm point in the zone should such momentary alarm condition be repetitive in nature.

A further object of the present invention is to provide zone or encoder circuitry capable of being connected to either normally open or normally closed alarm contacts with such circuitry producing an electrical pulse for transmission to a central office circuitry each time an alarm contact moves from its normal position to its alarm position.

An additional object of the present invention is to provide zone or encoder circuitry to which alarm contacts are connected in the same manner without regard to whether the alarm contacts are the normally open or normally closed type.

Still another object of the present invention is to provide zone or encoder circuitry which is connected to a plurality of alarm contacts which produces an electrical pulse for transmission to a central office circuitry each time an alarm contact moves from its normal position to its alarm position and continues to provide a lower level d.c. voltage signal to the central office circuitry so long as an alarm point remains in the alarm position.

Another object of the present invention is to reduce the number of wires in any cable needed to interconnect the major circuit portion of the system.

Other objects and advantages of the present invention will become apparent from the following description taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a block diagram showing of the major circuit portions as located in the schematic circuit FIG. 2; and

FIG. 2 is a schematic circuit of the alarm or surveillance system embodying the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

FIG. 1 shows the general location of the various major circuit portions that appear in FIG. 2. Blocks are used to identify the circuit portions and an identifying legend has been placed within each block. FIG. 1 also shows in a general way the interconnections that exist between the major circuit portions by the various blocks. Details regarding the interconnections for the circuit portions are shown in FIG. 2 and are described in detail in connection with the description for FIG. 2. FIG. 1 is used only to make it easier to locate the circuit details shown in FIG. 2 and should be referred to in connection with the description given regarding the general functions carried out by the circuitry in each block.

Referring to FIG. 1 the circuit portions identified in block form which are within the dotted line represent the circuitry that is physically located at a central console or central office and is referred to as the central office circuitry. The central office circuitry connects with the various alarm point encoders. Three such encoders are shown, one for each of the zones A, B and C. Each encoder connects with a number of different alarm contacts with as many as ten encoders being used, if needed. In practice, encoders having a ten alarm point capacity are usually used. Should an alarm point cause its alarm contact to move to the alarm position its associated circuitry in the encoder operates to transmit a pulse signal to the corresponding zone portion of the zone identification circuitry at the central office or central monitor. The appropriate zone portion of the zone identification circuitry is energized causing zone identifying light to be energized. Zone identification circuit is connected with the multivibrator so the zone identifying light presents a flashing signal in accordance with the frequency of the multivibrator.

The zone identification circuitry connects with the alarm indication circuitry via the alarm acknowledge switches. Energization of the circuitry for a zone in the zone identification circuitry causes the alarm indication circuitry to be energized to energize an alarm light and energize an audible alarm, if connected.

The operator acknowledges the alarm condition by momentarily operating the alarm acknowledge switch associated with the zone for which an alarm is indicated. This causes the associated zone portion of the zone identification circuitry to be modified so the zone identifying light provides a steady light and causes the alarm indication circuitry to be turned off. In addition, a voltage is applied to the associated zone encoder circuit and is routed via the circuitry associated with the point that is in alarm to the associated circuit portion of alarm point identification circuitry at the central office. Thus, the alarm point identification circuitry has a circuit portion for each alarm point that a zone alarm point encoder may have. Thus, if a given point in Zone A were in alarm the point circuit portion of the alarm point identification circuit associated with such point would be energized so long as the alarm acknowledge switch for Zone A was operated. An alarm point portion of the alarm point identification circuitry when so energized causes a point identification light to be energized. The particular alarm point in alarm and the zone involved is thus identified.

Prior art alarm or annunciator systems have the general arrangement and circuitry to provide the functions described. Additional novel features are provided by the invention presented herein. These will be discussed with the description of the details of the various major circuit portions of the system as shown in FIG. 2.

In prior art systems the zone or encoder circuitry is connected with the d.c. power supply and serves to route the d.c. voltage to the central office circuitry via a single output line for the encoder for initiating an alarm signal at the central office in response to movement of an alarm switch to the alarm position. Thus, any additional alarm conditions that occur for the encoder before the first condition is corrected will not cause a new alarm initiating signal to be sent to the central office circuitry.

The alarm point encoder circuitry for the various zones is shown in detail in Zone A in FIG. 2. The encoder circuitry for Zones B and C have circuitry identical to that for Zone A and is therefore represented by the blocks B and C. The alarm point encoder circuitry provides a pulse signal which is sent over the zone output wire to a zone portion of the zone identification circuitry of the central office circuitry. Thus, the wire OA is the zone output wire for Zone A. Zones B and C have output wires OB and OC, respectively, which are connected to their respective circuit portions of the zone identification circuitry in the central office circuitry. A pulse signal is sent each time an alarm point moves to the alarm position.

The encoder circuitry for Zones A, B and C are, for purposes of simplifying the description, shown connected to monitor only three alarm points or alarm contacts. As has been mentioned, the zone encoder circuitry is usually made with a ten alarm point capacity. As will be explained, the alarm points may present a normally open switch position or normally closed switch position. The alarm points or alarm switches for Zone A are shown at A1, A2 and A3. These switches are located at points remote from the encoder circuitry. Where identical circuitry is present in FIG. 2 a letter prefix or suffix will be used to designate the zone for the circuit component. Thus, B1 and C1 for Zones B and C, respectively, correspond to alarm point A1 for Zone A. Alarm points B2 and B3 for Zone B which correspond to alarm points A2 and A3, respectively, in Zone A are also shown in FIG. 2.

Each alarm point for the encoder circuitry has its own circuitry for developing the signal to be presented over the output line for the encoder. The circuitry applicable to alarm point A1 will be described and the various elements are referenced in FIG. 2 by using the small letters of the alphabet preceded by the number 1. Corresponding elements for the circuitry applicable to alarm point A2 will be referenced using corresponding letters with the prefix 2. The circuitry for A3 will use the small letters of the alphabet and the prefix 3. The circuitry associated with each alarm point can therefore be readily identified. There are also some components and conductors or connections used in each zone common to each alarm point circuit which should be identified. Such components and conductors in a zone are identified by numerals followed by the capital letter for the zone. Conductors 1A, 2A, 3A and

4A, for example, are common to the alarm point circuits in Zone A.

The encoder circuitry is powered from a d.c. power supply 1 located at the central office which provides three different voltage levels. One level of d.c. voltage is present at output 2. In the case of a system constructed in accordance with this invention level of d.c. voltage at output 2 was 14V. In practice a wire of a cable used to make interconnections between the alarm point encoders and the central office circuitry is used to apply the 14V to one of the encoders. This wire is identified in FIG. 2 as the conductor 1. The 14V d.c. voltage is then applied to Zone A via the conductor 1A, Zone B via conductor 1B and Zone C via conductor 1C. The conductors 1A, 1B and 1C are supplied by a cable making connections between the various zone encoders. Thus the conductor 1 plus conductors 1A, 1B and 1C connect the 14V terminal 2 of the d.c. supply 1 to the various encoders or zones. As shown for the Zone A encoder, conductor 1A connects with line 1A via a blocking diode 5A. The cathode of the diode 5A is connected to line 1A. The conductor 1A also connects to ground via a resistor 6A. Conductors 1B and 1C for Zones B and C are connected in a similar fashion with the encoder circuitry for Zones B and C.

Referring to alarm point A1, which uses a normally open switch, one side of the alarm switch connects to the common connector 1A. The other side of the alarm switch A1 connects with common conductor 4A via resistance 1a and also connects with the movable contact of a two state or position switch 1b. Since the alarm point A1 uses a normally open switch, the two position switch 1b has the movable contact place in contact with the contact labeled N.O. The two state or position switch 3b for the normally open alarm point A3 is similarly positioned. In the case of a normally closed alarm switch, such as alarm point A2, the two state or position switch 2b has its movable contact placed in contact with the contact labeled N.C. Thus, the two state or position switches 1b, 2b and 3b are positioned in accordance with the type of alarm point switches used for A1, A2 and A3, respectively.

It should be noted that the alarm switches for the encoders are connected to the encoder circuitry in the same manner without regard to whether they are normally open or normally closed. Thus, when an installation is made there is no need for knowing what type of alarm switch will be used before making the connections between the alarm points and the encoder circuitry. Once the type of alarm switch is known or if it is later changed to a different type, the two state or position switch, such as 1b, associated with the alarm switch can be positioned according to whether the alarm switch is the normally open type or normally closed type without making any other circuit changes.

The alarm point switch A1 is normally open and moves to the closed position when it is in an alarm condition. The closure of switch A1 thus connects line 1A with the two position switch 1b which is positioned to connect the switch A1 with the N.O. contact to apply 14V d.c. to a pulse forming circuitry. The pulse forming circuit made up of a capacitor 1c and a parallel connected resistor 1d is connected at one end to the N.O. contact of switch 1b and has its other end connected to common conductor 3A via a diode 1e which has its

cathode connected to common conductor 3A. Thus, upon movement of alarm point switch A1 to the closed or alarm position the 14V supplied from terminal 2 of the power supply via lines 1 and 1A and thence via blocking diode 5A and switch A1 to the pulse forming circuit causes a 10V pulse to be developed via the capacitor 1c at conductor 3A. A time constant of 1 millisecond has been used for the pulse. The signal then levels off at 2 volts. Another alarm switch moving to the alarm position will cause another 10V pulse to appear at conductor 3A which, of course, overrides the 2 volt level.

Each pulse produced by alarm conditions occurring for the Zone A encoder passes to the central office circuitry via the conductor OA. The conductor OA can thus be referred to as the zone or encoder output. Conductors OB and OC are the corresponding output lines for encoders B and C.

The 2 volt level at the encoder output OA is established by the resistor 7A connected to the N.O. contact of the switch 1b via the diode 1f. The anode of diode 1f connects with the N.O. contact. The other end of resistor 7A is connected to the common conductor 3A which in turn connects with the encoder output line OA. The resistor 7A with resistance provided at the central office establishes a voltage divider to place line OA at the 2 volt level after a 10V pulse has been transmitted via the line OA upon occurrence of an alarm condition. The resistance of resistor 1d is substantially greater than resistor 7A so even if all alarm points in an encoder were in the alarm condition the resistance presented by resistors 1d, 2d, etc., will not influence the voltage dividing function of resistor 7A. Resistors 1d, 2d and 3d serve to provide a discharge path for the capacitors 1c, 2c and 3c, respectively.

The point circuitry as thus described is the only portion of the encoder circuitry that is used when the alarm switch is of the normally open type. The remainder of the circuitry associated with an alarm switch comes into play when the alarm switch is the normally closed type. Reference is therefore made to the circuitry for alarm point A2 which is shown using a normally closed alarm switch. Since the A2 alarm switch is the normally closed type the two position switch 2b is positioned with the movable contact in contact with the N.C. contact. This being the case, the PNP transistor 2g, which has its collector electrode connected to capacitor 2c, must conduct in response to the opening of the alarm switch in order that a pulse signal will be produced at the encoder output OA upon movement of the alarm switch A2 to the open position. The emitter electrode of transistor 2g is connected to line 1A and is thus at a potential of 14V. The base electrode via the switch 2b and alarm switch A2 is also connected to line 1A. The base electrode is thus at the same potential as the emitter electrode so the transistor 2g is not conducting. A resistor 2h is connected at one end to line 1A and has its other end connected to one end of resistor 2a via the switch 2b. The other end of resistor 2a is connected to the common line 4A which connects to ground. Resistors 2a and 2h constitute a voltage divider which causes the voltage at the base electrode to be reduced when the alarm switch moves to the alarm position, i.e., opens, to make the transistor 2g conductive. Conduction of the transistor 2g via the

pulse forming circuit provided by capacitor 2c and resistor 2d causes a 10V pulse to be presented at the encoder output line OA.

When an alarm switch is of the normally open type the transistor associated with it will not conduct. For example, in the case of the normally open alarm switch A1, transistor 1g is held off since switch 1b is in the N.O. position. The base of transistor 1g which connects with line 1A via the resistor 1h is at the same potential as the emitter electrode and is not influenced by the position of the alarm switch A1.

In addition to providing an encoder output signal via line OA when an alarm condition occurs, the circuitry in the encoder also permits an alarm point interrogating or identification signal to be initiated at the central office which passes via the alarm point circuitry that is in alarm condition to a point output wire which connects with the point identification circuitry at the central office associated with the point that is in alarm. The point interrogating or identification signal is received over the output line OA and is applied to line 1A via a diode 8A which has its cathode connected to line 1A. Diode 5A prevents the point interrogating signal from passing to line 1A and diodes, such as 1e associated with the pulse forming circuitry, as well as diodes, such as 1f, prevent the interrogating signal from by-passing transistor 2g should alarm switch A2 be in the alarm position, i.e., open or by-passing an alarm switch which is closed for an alarm condition. Thus, assuming alarm switch A1 to be in the alarm position, i.e., closed, the point interrogating signal is applied via line OA, diode 8A, line 1A to switch A1, thence via switch 1b, a diode 1i to the output line AP1 (Zone A, alarm point 1) and thence to the point identification circuitry for the alarm point in the central office via a conductor P1. Similarly, alarm point outputs AP2, BP2 and CP2 are interconnected and connect with the central office circuitry via a conductor P2. In case a normally closed alarm switch such as A2 is in alarm, i.e., open, the interrogating signal path from conductor 1A to diode 2i is supplied by transistor 2g.

As shown in FIG. 1 the central office circuitry includes zone identification circuitry. As shown in FIG. 2, zone identification circuitry is provided for each zone which is triggered via a pulse signal received over the output line of the associated zone encoder. Thus, the output line OA for Zone A encoder connects with the Zone A identification circuitry at the central office. Zones B and C encoders are similarly connected to their zone identification circuitry via lines OB and OC, respectively. The zone identification circuitry for each zone is identical so only the zone identification circuitry for Zone A is shown in detail in FIG. 2 and will be described.

The d.c. supply 1 has an output 3 for supplying a higher voltage than is provided at terminal 2. An output of 24V d.c. from terminal 3 has been found to be suitable. A common conducting path 4 connects the 24V from terminal 3 to the zone identification circuitry, the point identification circuitry, the multivibrator and the alarm indication circuitry.

In the zone identification circuitry for Zone A the 24V d.c. is applied to the anode of a silicon controlled rectifier (SCR) 5 via series connected resistor 6 and diode 7. The cathode of diode 7 is connected to the

anode of SCR 5. The SCR 5 remains off until triggered to conduct in response to a signal applied to its gate electrode 8. Such a signal is provided by the 10V pulse received from the Zone A encoder which an alarm condition occurs. The 10V pulse is received over the conductor OA at the input 62 at one end of series connected resistors 9 and 10 and one end of series connected resistors 11 and 12. Resistors 10 and 12 are connected to the ground conductor 13. A Zener diode 14 is connected between the gate electrode 8 and the connection common to resistors 9 and 10. The gate electrode 8 is also connected to the ground conductor 13 via resistor 15. A capacitor 16 is also connected between the connection common to resistors 9 and 10 and the ground conductor 13. A 10V pulse received via conductor OA charges capacitor 16 until it reaches a voltage great enough to cause the Zener diode 14 to conduct. Conduction of Zener diode 14 develops a voltage across resistor 15 causing the gate electrode 8 to be effective to place the SCR 5 in a conducting mode. The SCR 5 connects to the ground conductor 13 via a diode 17 and the normally closed contacts of the series connected switches S1, S2 and S3.

The alarm indication circuitry includes a PNP transistor 18 which has its emitter connected to the 24V d.c. via the conductive path 4. The base electrode of the transistor 18 is also connected to the 24 d.c. voltage via resistor 19 causing the transistor to be in a non-conducting mode. The collector of the transistor connects to the ground conductor 13 via a lamp 20 and also connects to the ground conductor 13 via an audible alarm 21 and an adjustable resistor 22 used to adjust the sound level of the alarm. The base electrode of transistor 18 also connects with the anode of SCR 5 in the zone identification circuitry for Zone A via a resistor 23 and a diode 24. The resistor 23 is also connected in a similar manner with the zone identification circuitry for Zones B and C. The diode 24 has its cathode connected with the anode of SCR 5. Thus, when SCR 5 is conducting the voltage at its anode drops causing the voltage at the base of transistor 18 of the alarm indicating circuit to drop to turn on transistor 18. Conduction of transistor 18 in turn causes the audible alarm 21 and the lamp 20 to be energized to signal the presence of an alarm condition.

The zone identification circuitry for each zone also has a light which provides a flashing signal for the zone identification circuit that has been triggered by an alarm condition with the light presenting a steady visual signal after the alarm condition has been acknowledged. In the zone identification circuit for Zone A this is the lamp ZA which is energized when the PNP type transistor 25 is energized. The lamp ZA is connected between the collector of transistor 25 and the ground conductor 13. The emitter of transistor 25 is connected to the 24V d.c. present at conductor 4. The base of transistor 25 is connected to conductor 4 via a resistor 26 causing the transistor to normally be in a non-conducting mode. An NPN type transistor 27 has its collector connected to the base of transistor 25 via a resistor 28. When transistor 27 conducts the voltage at the base of transistor 25 is reduced causing it to conduct.

The transistor 27 cannot conduct unless the SCR 5 conducts or unless a Darlington circuit which includes

NPN type transistors 29 and 30 is conducting. This is due to the fact that the emitter of transistor 27 is connected to SCR 5 via diode 31 which has its cathode connected to the anode of SCR 5 with the emitter of transistor 27 also connected to the collectors of transistors 29 and 30 in the Darlington circuit. The base of transistor 27 is connected with the ground connection 13 via a resistor 61 and also connects via a resistor 32, diode 33 and resistor 6 with the line 4 which carries the 24V d.c. The diode 33 has its anode connected to the connection common to resistor 6 and diode 7. The connection of the base to line 4 thus provides the proper bias to keep the transistor 27 conducting when the SCR 5 is off and the Darlington circuit is conducting. The base of transistor 27 also connects with the collector of an NPN transistor 36 which is the output transistor for the multivibrator 37. The emitter of transistor 36 is connected to the ground conductor 13 and the collector connects via a resistor 38 to the 24V d.c. supply. The base of transistor 36 is connected to the multivibrator circuit 37 causing the transistor 36 to conduct in accordance with the frequency of operation of the multivibrator. The connection between the collector of transistor 36 and the base of transistor 27 is via a diode 34 which has its cathode connected to the connection common to resistor 32 and diode 33. Thus, a square wave signal which varies from nearly zero volts to 24V d.c. is presented to base resistor 32 of transistor 27. When SCR 5 is turned on in response to a 10V pulse received from Zone A due to the occurrence of an alarm condition, the emitter of transistor 27 is provided with a path to the ground conductor 13 via SCR 5 causing the transistor 27 to conduct. The transistor 27 is then under the control of the voltage supplied from the multivibrator 37 causing the transistor 27 to conduct in accordance with the multivibrator frequency. Conduction of transistor 27 causes the voltage at the base of transistor 25 to also vary in accordance with the frequency of the multivibrator 37 to cause transistor 26 to conduct in a pulsing fashion so the lamp ZA presents a flashing visual signal to indicate the presence of an alarm condition at Zone A.

The operator actuates switch S1 when a light ZA flashes causing the SCR 5 to be turned off. In the meantime the signal received from Zone A via line OA has leveled off to 2V d.c. which via resistor 11 and 12 presents the the base of transistor 29 of the Darlington circuit with a voltage sufficient to cause the Darlington circuit to conduct to provide transistor 27 with a path to ground conductor 13 even though SCR 5 may have been turned off. When the SCR 5 is turned off the voltage at the connection common to resistor 6 and diode 7 increases so the base of transistor 27 is presented with a steady instead of pulsating d.c. voltage causing transistor 27 to conduct at a given current level. Transistor 25, therefore, also will conduct at a given current level causing the lamp ZA to emit a steady light instead of a flashing light.

Even though the small d.c. voltage (2V) is presented to the zone identification circuit for a given zone when an alarm point in such zone is in the alarm condition, subsequent movement of another alarm point in such zone to the alarm position will cause a pulse (10V) to be presented to the central office circuitry causing the

associated zone identification circuit to respond to the pulse signal. Thus, should the identification zone circuit be the one for Zone A, which has just been described, with the lamp ZA giving a steady visual indication following acknowledgment of an alarm signal, the second pulse signal (10V) presented causes the SCR 5 to be turned on in the same manner as has been previously described. The audible alarm 21 and visual alarm 20 are then energized since the base voltage for transistor 18 drops due to conduction of SCR 5. The transistor 27 is again controlled by the multivibrator signal causing transistor 25 to be turned on and off in accordance with the multivibrator frequency. The lamp ZA again presents a flashing signal until the S1 acknowledge switch is operated to terminate the on mode of operation of SCR 5. The lamp ZA then emits a steady light since the low level (2V) d.c. signal is still received via the Zone A circuitry so long as there is at least one point in alarm to keep the Darlington circuit conducting which in turn causes transistors 25 and 27 to remain in the conducting mode.

The circuitry described enables the operator to identify the zone in which an alarm is presented. What remains to be described is the alarm point identification circuitry portion of the central office circuitry which enables the operator to establish the alarm point that is in alarm in a given zone.

The alarm point identification circuitry is made up of circuit portions PC1, PC2 and PC3, one for each alarm point in a zone encoder. The circuit portions PC1, PC2 and PC3 are alike except that each one is connected to a particular alarm point in each zone encoder. Thus, circuit portion PC1 connects with alarm point A1 of Zone A, B1 of Zone B and C1 of Zone C. Similarly, circuit portion PC2 is connected to the alarm point A2 of Zone A, B2 of Zone B, and C2 of Zone C (not shown).

The description which follows is for circuit portion PC1 but is also applicable to the other circuit portions PC2 and PC3. The circuit portion PC1 includes a two stage amplifier. The first stage includes an NPN transistor 39 which has its base electrode connected via a resistor 40 to line P1 which extends from the central office circuitry to one of the zone encoders where it connects with alarm point output lines AP1, BP1 and CP1 for alarm points A1, B1 and C1, respectively. A common conductor 41 connected to output 42 of the d.c. supply 1 connects with all of the circuit portions PC1, PC2 and PC3. It connects with the emitter electrode of transistor 39 in PC1 and the emitter electrodes of the corresponding transistors in PC2 and PC3. The common conductor 41 is also connected via a resistor 43 to the base of transistor 39 with a similar connection made in circuit portions PC2 and PC3. The voltage presented at output 42 is less than that at output 3 and greater than that at output 2. An output at 42 of 16V d.c. has been used in the case of a system made in accordance with this invention.

The conductor 4 connected to the 24V d.c. presented at output 3 of the d.c. supply 1 is also common to the circuit portions PC1, PC2 and PC3. Conductor 4 connects with resistor 44 in PC1 and with the corresponding resistor in the other circuit portions. The other end of resistor 44 is connected to the base of a PNP type transistor 45 of the second amplifier stage. The base of transistor 45 is also connected to one end

of a resistor 46 which has its other end connected to the collector of transistor 39. The emitter electrode of transistor 45 is connected to the common conductor 4 while the collector electrode of transistor 45 is connected via an incandescent lamp PL1 to the ground connecting conductor 47. The lamp PL1, when energized, provides a visual indication to the operator of the system that one of the first alarm point, i.e., A1, B1, or C1, in a zone encoder is the alarm position. Lamp PL2 provides visual indication for alarm points A2, B2 and C2 while lamp PL3 provides it for the third alarm point of Zones A, B and C. to the

Normally transistors 39 and 45 are not conducting and the occurrence of an alarm condition at one of the zone encoders is not effective to cause either transistor to conduct. Transistor 45, of course, will not conduct until transistor 39 conducts since the base and emitter electrodes of transistor 45 are at the same voltage when transistor 39 is not conducting. When transistor 39 conducts the voltage at the base of transistor 45 drops causing transistor 44 to conduct to energize lamp PL1. Until an alarm point moves to the alarm position the base and emitter electrodes of transistor 39 are at the same voltage, e.g., 16V d.c., so transistor 39 does not conduct. Of course, transistor 39 will not conduct even though an alarm point when in alarm causes the base electrode of transistor 39 to be connected to the d.c. supply 1 via the zone encoder circuitry. Such connection is made to the 14V d.c. output at 2 of the d.c. supply 1 which is lower than the 16V d.c. presented to the base of transistor 39 via resistor 43 so transistor 39 remains off.

It can be seen that the connection of resistor 40 to the output 3 of the d.c. supply 1 to apply 24V d.c. to the base of transistor 39 will cause transistor 39 to conduct which in turn will cause transistor 45 to conduct. The lamp PL1 will then be energized. Connection of resistor 40 to the 24V d.c. available at the output 3 of the d.c. supply 1 is accomplished when either alarm point A1, B1 or C1 are in the alarm position and the associated alarm acknowledge switch at the central office is operated.

Operation of the alarm acknowledge switches has been mentioned in connection with the acknowledgment of a zone alarm indication. It should be noted that two switches have been included in the structure of each of the acknowledge switches S1, S2 and S3. The normally closed switch portions 48, 49 and 50 of switches S1, S2 and S4, respectively, are connected to provide a series connection to the ground conductor 13 from SCR 5 of the Zone A identification circuitry and the corresponding SCR's for the other zone identification circuits in the zone identification circuitry. An alarm acknowledge switch is provided for each zone circuit portion of the zone identification circuitry since the switches S1, S2 and S3 when operated also serve to connect an alarm point interrogation signal (24V d.c.) to encoder output lines OA, OB and OC, respectively. This is accomplished by closure of the normally open switch portions 51, 52 and 53 of switches S1, S2 and S3, respectively. One contact of each of switches 51, 52 and 53 is connected via a resistance 54 to the common conductor 4 while the other contact for switches 51, 52 and 53 is connected to the encoder output lines OA, OB and OC, respectively.

The latter connection is made in the zone identification circuitry at the point where the associated encoder output line is connected. In case of the Zone A identification circuitry, such connection is made at the input 62 where encoder output line OA is connected. Accordingly, when SCR 5 is made conductive in response to a pulse signal received from the Zone A encoder the operator operates alarm acknowledge switch S1 to first open switch portion 48 and then close the switch portion 51. Conduction of SCR 5 is terminated by the opening of switch portion 48 while the closing of switch portion 51 applies the 24V d.c. present at common conductor 4 to the Zone A encoder via the line OA.

Assuming alarm point A1 was the point in alarm, the 24V d.c. alarm point interrogation signal is applied to line 1A via diode 8A. Any other path from the point of connection of OA to the encoder circuitry for Zone A is blocked by the various diodes in the circuitry. The conducting path continues from line 1A via the closed alarm switch A1, the switch 1b, diode 1i to the alarm point output line AP1 which connects between the corresponding alarm points in the various zone encoders. The AP1 line connects with the alarm point 1 circuitry PC1 in the alarm point identification circuitry at the central office via line P1. With 24V d.c. connected to the resistor 40, the base electrode of transistor 39 is presented with a high enough voltage to cause it to conduct. Conduction of transistor 39 causes transistor 45 to conduct to energize lamp PL1 to indicate that the alarm point A1 of Zone A is in the alarm position.

The foregoing explanation covers the operation of the system when an alarm switch moves to the alarm position and remains in that position at least until the alarm point has been identified. There are cases where an alarm switch may move only momentarily to the alarm position. In such a case the encoder will only present the electrical pulse to the zone identification circuitry and there will be no 2 volt d.c. signal presented. Thus, for example, should alarm switch A1 close momentarily an electrical pulse will be sent over conductor OA to cause SCR 5 to be turned on. Conduction of the Darlington circuit will, of course, be only for the duration of the pulse signal. Conduction of SCR 5, however allows transistor 27 to conduct via the diode 31. Conduction of transistor 27 causes transistor 25 to conduct to energize the zone lamp ZA to indicate an alarm condition has been presented by an alarm point connected to zone encoder A. Since the alarm switch A1 has been assumed to have closed only momentarily, the alarm point interrogating signal applied upon operation of the alarm acknowledge switch S1 does not have a path through the alarm point A1 encoder circuitry. The alarm point A1 which closed momentarily cannot be identified. Zone A has, however, been established as having presented a momentary alarm condition.

In case such a momentary alarm condition became repetitive, the operator need only keep the appropriate alarm acknowledge switch operated. Thus, were alarm switch A1 to repeatedly move momentarily to the alarm position, the operator can keep alarm acknowledge switch S1 operated. The next closure of alarm switch A1 will allow the alarm point interrogating signal presented by closure of switch S1 to pass to the point identification circuit portion PC1 causing the

light PL1 to be energized during the momentary closure of alarm switch A1 thus establishing alarm switch A1 as the one which is momentarily closing.

The use of the output line from an encoder, such as line OA of Zone A encoder, to apply the alarm point interrogation signal to the zone identification circuitry reduces the number of wires needed for making the interconnections between the central office circuitry and the zone encoders and for connecting between the encoders. In the case of a system using ten encoders with each having ten alarm switches a cable with only 22 conductors need be used. In the case of a system of this size made in accordance with the disclosure in U. S. Pat. No. 3,518,653 a cable with thirty one conductors is needed. A reduction in the number of wires needed, of course, represents a substantial reduction in cost of installing a system.

It should be noted that a diode 55 with its anode connected to the ground conduction 13 is connected in parallel with the switches S1, S2 and S3. This diode 55 is used to eliminate the creation of a biasing voltage due to the resistance presented at the contacts for switch portions 48, 49 and 50. This may be a problem when a system using as many as ten alarm acknowledge switches is made in accordance with the invention. Thus, without the diode 55 it has been found that a transient signal introduced into the system may cause a large enough voltage drop across the series connected alarm acknowledge switches S1, S2 and S3 to cause one or more of the SCR's such as SCR 5 to conduct.

Details of the free running multivibrator 37 have not been given since it is of standard construction. It includes two NPN transistors 56 and 57 which alternately conduct as is the normal operation for a free running multivibrator. Thus, when transistor 56 is conducting transistor 57 is not conducting and vice versa. The rate at which this takes place is determined by the RC time constants built into the circuitry. The output of the multivibrator is substantially a square wave signal. It should be noted that the multivibrator 37 is operated at a voltage that is less than the 24V d.c. supplied from the d.c. supply 1. A dropping resistor 58 is connected between conductor 4 and the multivibrator circuit to lower the voltage presented to the multivibrator. The voltage for the multivibrator is stabilized by the use of the Zener diode 59 and a capacitor 60 is connected across the Zener diode 59 to by-pass any alternating current signals that may be presented. The capacitor 60 and the reduction of the voltage used for operation of the multivibrator serves to prevent the multivibrator from locking in on the 60 cycle ripple that is present in the output of the d.c. power supply 1.

Inasmuch as the present invention is subject to a variety of modifications and changes in detail as may be apparent to one skilled in the art, it is intended that all matter contained in the above description as shown on the accompanying drawing, shall be interpreted as illustrative and not in a limiting sense.

What is claimed is:

1. Direct current operated zone encoder circuitry for connection with normally open and/or normally closed alarm switches for a multiple point alarm system comprising:

a common conductor to which one side of each alarm switch connected to the encoder is connected;

an output conductor;

a plurality of circuit means, one for each alarm switch, connected to said output conductor, each circuit means including a selector switch connecting with the other side of an alarm switch, said selector switch when in one position serving to connect the alarm switch to the circuit means at one point when the alarm switch is of the normally open type to cause said circuit means to present an electrical signal at said output conductor when the normally open alarm switch closes, and said selector switch when in a second position serving to connect the alarm switch to the circuit means at another point when the alarm switch is of the normally closed type to cause said circuit means to present an electrical signal at said output conductor similar to said first mentioned electrical signal, thereby permitting the alarm switches to be connected to the encoder without first requiring knowledge of the type of alarm switch being connected;

a resistor having one end connected to said output conductor and the other end connected to said circuit means;

said circuit means including a semiconductor device having one electrode connected to said common conductor, a second electrode connected to said selector switch when in said second position and a third electrode connected to said selector switch when in said one position; and

said circuit means having a diode connected between said third electrode and said resistor.

2. Direct current operated zone encoder circuitry for connection with normally open and/or normally closed alarm switches for a multiple point alarm system comprising:

a common conductor to which one side of each alarm switch connected to the encoder is connected;

an output conductor;

a plurality of circuit means, one for each alarm switch, each circuit means including a selector switch, a semiconductor device and a pulse forming means, said selector switch connecting with the other side of an alarm switch, said selector switch being placed in one position when a normally open alarm switch is connected to said switch and being placed in a second position when a normally closed alarm switch is connected to it, said semiconductor device connected to said common conductor, said pulse forming means connected at one end to said output conductor, said pulse forming means connecting at its other end with said selector switch and said semiconductor device, said pulse forming means being energized via said semiconductor device when said selector switch is in said one position and the connected alarm switch initially moves to the alarm position to produce an electrical pulse at said output conductor and being energized via said selector switch and the connected alarm switch when said selector switch is in said other position and the connected alarm switch initially moves to the alarm position to produce an electrical pulse at said output conductor;

a resistor having one end connected to said output conductor; and

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said circuit means including a diode connected between said other end of said pulse forming means and the other end of said resistor, said diode having its anode connected to said other end of said pulse forming means.

3. A multiple point alarm system for monitoring at a central station a plurality of remote zone encoders, each connected to a plurality of alarm switches comprising:

a d.c. voltage supply at the central station having at least two output levels;

each zone encoder having a common input conductor;

means connecting one of said d.c. supply output levels to said common input conductor;

each zone encoder having a zone output and an alarm point output for each alarm switch connected to an encoder, a zone encoder presenting an electrical signal at said zone output when an alarm switch connected to the encoder moves to the alarm position, a zone encoder also presenting a d.c. path between said zone output and an alarm point output when the alarm switch for the alarm point output is in the alarm position;

a plurality of zone indicating circuit means at the central station, one for each zone encoder, each zone indicating circuit means having an input;

a zone output conductor for each zone encoder connecting the zone output of a zone encoder to the input of a zone indicating circuit means;

a plurality of alarm point indicating circuit means at the central station each connected to one of said alarm point outputs in each of said zone encoders, each of said alarm point indicating circuit means requiring the other of said two output levels of said d.c. voltage supply to be applied to place the alarm indicating circuit means in operation; and

a normally open switch at the central station for each of said zone indicating circuit means, said switch for a given zone indicating circuit means connecting the other of said two output levels of said d.c. voltage supply to the input of said given zone indicating circuit means when said switch is operated to the closed position, said other of two output levels of said d.c. voltage supply thereby being applied to one of said plurality of alarm point indicating circuit means via said zone output conductor connected to said given zone indicating circuit means to the connected zone encoder and thence via said d.c. path presented in a zone encoder by an alarm switch in the alarm position and the associated alarm point output.

4. A multiple point alarm system in accordance with claim 3 wherein said d.c. path for each encoder includes a diode in each encoder connected between the zone output and the common input conductor.

5. A multiple point alarm system for monitoring a

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plurality of normally open and/or normally closed alarm switches comprising:

zone encoder circuit means and zone identification circuit means, means connecting said zone encoder circuit means to said zone identification circuit means comprising a single output from said zone encoder circuit means, said zone encoder circuit means connected to said alarm switches, said zone encoder circuit means providing a single electrical pulse at said single output in response to each movement of any of said alarm switches to the alarm position, said zone encoder circuit means, after one of said electrical pulses is produced, providing a direct current signal at said single output which remains for so long as any of said alarm switches are in the alarm position, said zone identification circuit means having a first, second and third semiconductor means, said first semiconductor means including a gated semiconductor device, said first and third semiconductor means connected to said single output, said first semiconductor means triggered to conduct in response to said electrical pulse, said third semiconductor means conducting in response to said direct current signal, said second semiconductor means connected to said first and third semiconductor means, said second semiconductor means conducting in response to conduction of either of said first and third semiconductor means, and a signal means included in said zone identification circuit means connected to said second semiconductor means, said signal means being energized when said second semiconductor means is conducting.

6. A multiple point alarm system in accordance with claim 5 further including a multivibrator circuit connected to said second semiconductor means, said multivibrator circuit providing a periodic signal to said second semiconductor means causing said second semiconductor means to conduct in accordance with said periodic signal when said second semiconductor means is conducting in response to conduction of said first semiconductor means.

7. A multiple point alarm system in accordance with claim 5 further including manually operable means when operated terminating conduction of said first semiconductor means permitting movement of another of said alarm switches to the alarm position to provide another electrical pulse to be applied to said first semiconductor means to again trigger said first semiconductor means to conduct.

8. A multiple point alarm system in accordance with claim 5 wherein said first semiconductor means includes a Zener diode connected to said gated semiconductor device preventing said gated semiconductor device from being gated to conduct by said direct current signal.

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